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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/478,731	01/06/2000	Charles W. Wampler II	H-205672	2074

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EXAMINER	
DAY, HERNG DER	
ART UNIT	PAPER NUMBER
2123	

DATE MAILED: 03/13/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/478,731	WAMPLER, CHARLES W.	
	Examiner	Art Unit	
	Herng-der Day	2123	

-- The MAILING DATE of this communication appears on the c ver sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *06 January 2000* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-9* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-9* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *06 January 2000* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

1. Claims 1-9 have been examined and claims 1-9 have been rejected.

Drawings

2. The drawings are objected to for the following reasons. A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

2-1. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the methodology of process steps must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

2-2. The drawing of FIG. 9 is objected to as failing to comply with 37 CFR 1.84(p)(5) because it does not include the reference sign 40 as mentioned in line 9 of page 26 in the specification.

2-3. It appears that "RETURN TO PONCE", as shown in FIG. 12, should be "RETURN TO POUNCE".

Specification

3. The Examiner requests copies of the following publications referred to in the specification because they appear to be reasonably necessary to the examination of this application and cannot be located.

(1) R. P. Paul, "Robot Manipulators: Mathematics, Programming, and Control", MIT Press, Cambridge, MA, 1981, referred to in lines 8-10 of page 14.

(2) Orin and Shrader [1984], referred to in line 24 of page 22.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 1-9 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

5-1. Claim 1 recites the limitation "each member of the pair being one of the embedded coordinate systems of said workpiece of said rigid bodies of said devices" in lines 24-25 of the claim. There is insufficient antecedent basis for this limitation in the claim. For the purpose of claim examination, the Examiner will presume that "said workpiece of said rigid bodies of said devices" as described in line 25 of the claim refers to "said workpiece or said rigid bodies of said devices".

5-2. Claims 2-9 are rejected as being dependent on a rejected claim.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claims 1-3 and 8-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matsuzaki et al., U.S. Patent 5,357,439 issued October 18, 1994, and Applicant's admission in view of Spector, U.S. Patent 6,004,016 issued December 21, 1999.

7-1. Regarding claim 1, in addition to Applicant's admission, as described in lines 18-19 of page 13, "several of the steps can be accomplished using commercially available software", Matsuzaki et al. disclose a production planning system (column 1, line 47 through column 3, line 25). "Based on the definition of the production planning system, the optimum equipment arrangement for a product specification is realized, resulting in allowing the product to be manufactured very efficiently" (column 3, lines 3-6).

Specifically, Matsuzaki et al. disclose a method of arranging at least one workpiece and one or more workpiece processing devices in a manufacturing cell using a programmable computer with a database (database 3-1, FIG. 4; column 8, lines 27-34), each said device either consisting of a rigid body or comprising two or more rigid bodies connected by kinematic joints, one of which bodies is declared to be the base link of said device, and each said workpiece and said rigid bodies having one or more virtual embedded coordinate systems, said method comprising:

entering a geometric description of said manufacturing cell in said database (common stage 4-W, FIG. 45 and FIG. 46; column 30, lines 14-16);

entering a geometric description for each said workpiece and workpiece processing device including kinematic and limit of motion data for each said joint of said devices into said database (various data in database 3-1, FIG. 4; robot simulation packages, page 14 of the specification, lines 12-13);

entering in said database an initial position and orientation of each workpiece and each base link, in which location each is either attached to ground in the cell or to another rigid body (data, column 25, lines 28-33; attachment, page 14 of the specification, lines 21-22);

entering in said database a tree structure of program steps, the root node of said tree containing a value for each joint of each device in said manufacturing cell at some initial time, and each child node of a particular node in said tree representing an alternative motion in terms of a list of devices which will move should that alternative be chosen, and containing for each joint of each such moving device a value to be attained at the completion of the motion (tree-structure, column 22, lines 39-43);

entering in said database identification of attracting pairs of coordinate systems, each member of the pair being one of the embedded coordinate systems of said workpiece or said rigid bodies of said devices at a specified program step (combining a positioning unit and a posture positioning unit, column 2, line 67 through column 3, line 2);

identifying in said database those workpiccs and base links whose locations are to be moved from their initial positions and orientation and those joints whose values are to be adjusted, such movements and adjustments being optimized with respect to said attracting pairs and repelling pairs (designing the manufacturing process, column 8, lines 34-37).

subjecting prospective locations and joint values to a mathematical optimization analysis to achieve an arrangement of each said workpiece and devices in said cell in which said attracting pairs of coordinate systems are coincident, said repelling pairs are separated, and said joint values all lie within said limits of motion (optimum equipment arrangement, column 3, lines 3-6; known optimization software program, page 3 of the specification, lines 10-12).

Although Matsuzaki et al. disclose a production planning system such that the optimum equipment arrangement for a product specification is realized, Matsuzaki et al. fail to expressly disclose the identification of repelling pairs.

Spector discloses a method and apparatus for path planning and execution of movements of multiple mobile objects in a common workspace by combining configuration space path planning with collision avoidance during the movement execution phase, thereby providing a convenient and practical solution to the multiple manipulator problem. The collision avoidance control signal derived from an artificial force field model generates repulsion forces based on mutual proximity of the objects (abstract; column 2, line 66 through column 5, line18). Specifically, Spector discloses the missing element:

entering in said database identification of repelling pairs, each member of which is a workpiece or device in said manufacturing cell (potentially colliding components, column 9, lines 20-32);

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of Matsuzaki et al. to incorporate the teachings of Spector to obtain the invention as specified in claim 1 because with collision avoidance a convenient and practical solution to the multiple manipulator problem has been provided (Spector, column 5, lines 11-15).

7-2. Regarding claim 2, Matsuzaki et al. further disclose using computer graphics to display said manufacturing cell, workpieces, processing devices, attracting pairs and repelling pairs, and to indicate those workpieces, base links and joints which are subject to optimization (display unit

3-5, FIG. 4; column 8, lines 42-45; Commercial simulation packages, page 15 of the specification, lines 10-11).

7-3. Regarding claim 3, Matsuzaki et al. further disclose that said computer comprises a graphical user interface and said method comprises using said graphical user interface to add, delete or modify the entering of said geometric descriptions and positions and orientations of workpieces and devices in the said database, allowing said manufacturing cell arrangement to be created iteratively and allowing complex arrangements to be developed in several stages of increasing complexity (data input unit 3-2, FIG. 4; column 8, lines 34-45; Commercial simulation packages, page 15 of the specification, lines 10-11).

7-4. Regarding claim 8, Matsuzaki et al. fail to expressly disclose the function to be optimized is formed as a weighted sum of contributions from each attracting pair, repelling pair, and joint value.

Spector discloses a method and apparatus for path planning and execution of movements of multiple mobile objects in a common workspace by combining configuration space path planning with collision avoidance during the movement execution phase, thereby providing a convenient and practical solution to the multiple manipulator problem. The collision avoidance control signal derived from an artificial force field model generates repulsion forces based on mutual proximity of the objects (abstract; column 2, line 66 through column 5, line18). Forms of the hypothetical repulsion force equation may include the term "$1/r^2$" or any other monotonically decreasing function of relative distance (column 9, lines 20-26). In other words, Spector discloses that the function to be optimized should include functions of relative positions.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of Matsuzaki et al. to incorporate the teachings of Spector to obtain the invention as specified in claim 8 because the collision avoidance force model incorporates the hypothetical repulsion force equation and with collision avoidance a convenient and practical solution to the multiple manipulator problem has been provided (Spector, column 5, lines 11-15).

7-5. Regarding claim 9, Matsuzaki et al. further disclose when the location of a workpiece or base link is selected for optimization, the freedom to adjust the position and orientation can be restricted to be any subset among translation along and rotation about the three coordinate directions of a coordinate system selected from among those embedded in the body or in the body to which it is attached (moving or rotating, column 22, lines 31-38).

8. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combined teachings of Matsuzaki et al., U.S. Patent 5,357,439 issued October 18, 1994, and Spector, U.S. Patent 6,004,016 issued December 21, 1999, as applied to claim 1, and further in view of Applicant's admission.

8-1. Regarding claim 4, Matsuzaki et al. fail to expressly disclose that the corresponding continuous motion through the sequence can be animated using computer graphics. However, Applicant suggests that commercial simulation packages may provide such animation in lines 10-11, page 15 of the specification.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of Matsuzaki et al. to incorporate the commercial simulation

packages as Applicant suggested to obtain the invention as specified in claim 4 because through animation the designer will have a much better understanding of the overall designed process.

9. Claims 5-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combined teachings of Matsuzaki et al., U.S. Patent 5,357,439 issued October 18, 1994, and Spector, U.S. Patent 6,004,016 issued December 21, 1999, as applied to claim 1, and further in view of Tandler, U.S. Patent No. 5,949,693 issued on September 7, 1999.

9-1. Regarding claims 5-7, Matsuzaki et al. fail to expressly disclose assigning said attracting pairs as consisting of attraction between: (1) the origin points of the coordinate systems of said pairs; (2) the line segment from origin to secondary point of the respective bodies; and (3) congruent geometric entities. Nevertheless, Matsuzaki et al. do suggest measuring the relative position for the purpose of calibrating the coordinate axis and allowing the object to be positioned in any place and posture (column 29, lines 14-29).

Tandler discloses a CAD system for automatically constructing datum reference frame (DFR) for machine part. The DRF construction tools are applied in order to eliminate pitch, yaw, roll, and translation from the DRF (abstract). DRF is a Cartesian coordinate system relative to which the locations and attitudes of machine part features are defined. A DRF is not a physical entity but rather an imaginary construct to which physical features on a part are geometrically related (column 1, lines 36-42). In other words, Tandler discloses various relationships and manipulations between coordinate systems. Specifically, Tandler discloses the missing elements:

(Claim 5) assigning said attracting pairs as consisting of attraction between the origin points of the coordinate systems of said pairs, leaving the relative orientation of the coordinate systems free (1st interim coordinate system, Figure 16a, set origin).

(Claim 6) assigning said attracting pairs as consisting of attraction between the origin points of the coordinate systems and attraction between a secondary pair of points of said systems, said secondary points being a specified non-zero distance along a specified direction of the said coordinate systems, thus causing the line segment from origin to secondary point of the respective bodies to align while leaving rotation about that line segment free (2nd interim coordinate system, Figure 16a, align line segments in Z).

(Claim 7) assigning said attracting pairs as consisting of attraction between the origin points of the coordinate systems of said attracting pairs and attraction between two or more additional pairs of points of each of said systems, forming congruent geometric entities, so that bringing the corresponding points into coincidence fully constrains the relative orientation of said attracting pairs (4th interim coordinate system, Figure 16a, congruent geometric entities).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of Matsuzaki et al. to incorporate the teachings of Tandler to obtain the invention as specified in claims 5-7 as suggested by Matsuzaki et al. to allow the object to be positioned in any place and posture (column 29, lines 14-29).

Conclusion

10. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Reference to Cohn et al., U.S. Patent 5,745,735 issued April 28, 1998, is cited as disclosing localized simulated annealing.

Reference to Rongo, U.S. Patent 6,292,715 issued September 18, 2001, and filed October 27, 1999, is cited as disclosing a robotic process planning method using templates.

Reference to Barral, U.S. Patent 6,470,301 issued October 22, 2002, and filed November 24, 1999, is cited as disclosing optimization tool for assembly workcell layout.

Reference to Lueth, "Automated Planning of Robot Workcell Layouts", Proceedings of the 1992 IEEE International Conference on Robotics Automation, May 1992, pages 1103-1108, is cited as disclosing planning of robot workcell layouts.

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Herng-der Day whose telephone number is (703) 305-5269. The examiner can normally be reached on 8:30 - 17:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kevin J Teska can be reached on (703) 305-9704. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 746-7239 for regular communications and (703) 746-7238 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 305-3900.

Herng-der Day
March 10, 2003

HUGH JONES Ph.D.
PRIMARY PATENT EXAMINER
TECHNOLOGY CENTER 2100